RDECOM-TARDEC
Development of Ground Vehicle Fuel Cell Auxiliary Power Units (APUs)

Briefing Questions

For other questions you would like answered,

Please contact:

MAJ Ed Leathers

leathere@tacom.army.mil

(586) 574-6133

Herb Dobbs

dobbsh@tacom.army.mil

(586) 574-5157

ATTENTION:
The following questions are the majority that were asked at our two day Industry Day briefing. They may have been worded differently or combined with other questions.

Questions

ATTENTION:

The RFP will override any answer that is given (if different)

1. How is the project funded?
2. What is the Army ultimately looking for from this project?
3. What are the power requirements?
4. Is the program being coordinated with the Marines?
5. What is turndown?
6. What are numbers for acoustic and thermal signatures?
7. If looking for minimal acoustic and thermal signature, how will that be demonstrated that on a brassboard?
8. What are the start temperature and start time requirements?
9. Should it be assumed that battery power will be available for cold start?
10. Can vehicle batteries be used for load leveling?
11. Can vehicle batteries be used for transient response?
12. Are you going to use ambient air that may include combat zone requirements?
13. Is there a weight target for the system?
14. Do we need to demonstrate the packaging for the system?
15. Is there a required shape or form factor?
16. Will the specified volume have to include fuel?
17. What are the JP-8 fuel specifications?
18. Is there a total efficiency mark?
19. Will the brassboard be subjected to battlefield vibration conditions?
20. What about freezing?
21. How many awards are expected?

Questions

ATTENTION:

The RFP will override any answer that is given (if different)

22. Can water be a reactant? Can external water be provided for startup?
23. Does the brassboard have to be demonstrated in a relevant environment? What is the TRL?
24. Does the brassboard have to meet all final weight and volume requirements?
25. Any preference to specific technology (SOFC or PEM)?
26. **In the RFP the government is requesting a TRL 5 brass board, does the government plan on developing this further?**
27. Is cost sharing required?
28. Is this open to just fuel cells or can other technologies be used to meet the requirements?
29. Will there be specific requirements for partnerships with universities or industry?
30. What is the potential quantity down the road? Procurement Quantity?
31. Will the level of funding available be specified in the RFP?
32. Will a hybrid fuel cell system be an option?
33. Is there a possibility of adding a dual-use requirement?
34. Scalability between three combat vehicles – how is that demonstrated, are three brass boards needed?
35. What is meant specifically by “major maintenance requirements”?
36. If the fuel cell is insulated so that it can be touched by hand, is this a measure of heat signature?
37. Will there be guidance on how much cycling is done? (ex. Full power, off for 2 days, on 2 hrs)
38. Will the APU require its own JP-8 fuel pump, or will it be able to use the vehicle engine’s fuel pump?
39. Is there any consideration of integrating the fuel cell APU cooling system with the existing vehicle cooling system?
40. Can the fuel cell APU be used for comfort heating?
41. What is the definition of all the TRLs (Technology Readiness Levels)?

Q&A

1. **Q: How is the project funded?**
   A: The program shall be funded by Army budgeted Research, Development and Engineering funds. The program is covered by an approved Science and Technology Objective (STO), which helps to ensure the availability of the out year funds.

2. **Q: What is the Army ultimately looking for from this project?**
   A: We would like a JP-8 fuel cell APU brass board system at the end of Phase I. This brass board needs to be at TRL 5. Follow on goal is integration into a combat vehicle.

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Q&A

3. Q: What are the power requirements? In the briefing, a 5-20 kW vehicle range was given, is that what is wanted specifically?

A: The plan for the program is to address the auxiliary power needs of the Bradley, Abrams and Stryker vehicles. Each of these vehicles have different configurations and variants, which have different requirements. *At this time* we are specifying power levels as a range, 5-20kW. The target will be refined in the final request for proposal.

Abrams would like to see 6kW, 10 kW is better. Varied numbers for each vehicle. Also Depends on the functionality of the vehicle

Bradley would like to see 3-6 kW or 8 kW.

Stryker - TBD

Discreet levels will be provided later

4. Q: Are we/will we be working with the Marines?

A: We are partnering with the Office of Naval Research (ONR) to work with them.

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Q&A

5. Q: What is turndown?

A: The turndown ratio is the ratio of the rated power to the lowest stable operating power. In this development, it is foreseen that an APU would have to be capable of a 10:1.

6. Q: What are numbers for acoustic and thermal signatures?

A: Not defined yet. We hope to have the specific values in the RFP.

7. Q: If looking for minimal acoustic and thermal signature, how will that be demonstrated that on a brassboard?

A: The acoustic and thermal signatures shall not be demonstrated on the brassboard, but will most likely be required as part of the path forward documentation.

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Q&A

8. Q: What are the start temperature and start time requirements?

A: We are working the managers of the three vehicles to identify all requirements, including start up performance. At this time, our best understanding is to target a 30 min startup from ambient. The system should also be able to operate in a hot stand-by mode and be able reach full power in “couple of minutes”.

9. Q: Should it be assumed that battery power will be available for cold start?

A: Yes

10. Q: Can vehicle batteries be used for load leveling?**

A: We are leaving that decision up to the proposal offerors.

11. Q: Can vehicle batteries be used for transient response?**

A: We are leaving that decision up to the proposal offerors.

****Clarification: Vehicles will still keep their standard batteries****

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Q&A

12. **Q: Are you going to use ambient air that may include combat zone requirements?**

    A: Yes

13. **Q: Is there a weight target for the system?**

    A: Power density will most likely be the driving physical attribute for the system, as such we most likely will not be emphasizing weight or specific power and requirements in the request for proposal.

14. **Q: Do we need to demonstrate the packaging for the system?**

    A: The overall program will likely include an effort to demonstrate the packaging for the APU. This may be part of the evaluation criteria for the potential follow on contract.

15. **Q: Is there a required shape or form factor?**

    A: To be determined in the RFP

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Q&A

16. Q: Will the specified volume have to include fuel?

A: No, because the APU will use fuel from the vehicles fuel tank.

17. Q: What are the JP-8 fuel specifications?

A: The request for proposal will have the final definition for JP-8 requirements. The specification for JP-8 is called out in MIL-DTL-83133E. In 2003, the average worldwide sulfur content of JP-8 was about 500 ppm, but sulfur levels are regularly seen at the spec limit of 3000 ppm. The system will need to be able to survive all fuel that is within specs.

18. Q: Is there a total efficiency mark?

A: It is unlikely that efficiency will be a driving key performance parameter for this development.

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Q&A

19. **Q: Will the brassboard be subjected to battlefield vibration conditions?**

    A: No, but the path forward should show that the eventual APU will meet MIL STD 810F.

20. **Q: What about freezing?**

    A: The system should be to be able to survive freezing conditions. This is an attribute that will be more critical going to a phase II development.

21. **Q: How many awards are expected?**

    A: It is our intent to make from zero to three awards.

22. **Q: Can water be a reactant? Can external water be provided for startup?**

    A: Water can be used as a reactant, but make-up water can not be required except at major maintenance intervals.

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Q&A

23. Q: Does the brassboard have to be demonstrated in a relevant environment?

A: Yes, as per the required TRL 5 level of development. See attachment describing the TRL levels.

24. Q: Does the brassboard have to meet all final weight and volume requirements?

A: Not the full weight and volume, but a path forward to achieve final APU packing requirements should be shown.

25. Q: Any preference to specific technology (SOFC or PEM)?

A: No.

26. Q: In the RFP the government is requesting a TRL 5 brass board, does the government plan on developing this further?

A: Yes, We tentatively plan on a having a follow-on contract after this one which will further develop the phase 1 effort into a vehicle demonstration TRL 6/7 level of development. However, all future efforts are dependent on technical progress and availability of funding.

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Q&A

27. **Q: Is cost sharing required?**
    A: No.

28. **Q: Is this open to just fuel cells or can other technologies be used to meet the requirements?**
    A: The development is specific to fuel cells.

29. **Q: Will there be specific requirements for partnerships with universities or industry?**
    A: No.

30. **Q: What is the potential quantity down the road? Procurement Quantity?**
    A: The number will potentially come out in Phase II but it will go on 3 classes of combat vehicles, however, not on all vehicles in a class.

31. **Q: Will the level of funding available be specified in the RFP?**
    A: The RFP should list the available funding as a range.

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Q&A

32. **Q: Will a hybrid fuel cell system be an option?**
    A: The RFP will probably not specify an approach.

33. **Q: Is there a possibility of adding a dual-use requirement?**
    A: The RFP will probably not specify an approach.

34. **Q: Scalability between three combat vehicles – how is that demonstrated, are three brass boards needed?**
    A: Three brass boards are not required. Scalability requirements, if any, will be spelled out in the RFP.

35. **Q: What is meant specifically by “major maintenance requirements”?**
    A: TBD.

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Q&A

36. **Q: If the fuel cell is insulated so that it can be touched by hand, is this a measure of heat signature?**

    A: That is not a direct measure of heat signature. Heat signature deals with detecting warm solid objects or plumes of exhaust gas.

37. **Q: Will there be guidance on how much cycling is done? (ex. Full power, off for 2 days, on 2 hrs)**

    A: Data on Silent Watch Mission Requirements are being collected to better answer this question.

38. **Q: Will the APU require its own JP-8 fuel pump, or will it be able to use the vehicle engine's fuel pump?**

    A: The APU will most likely require its own fuel pump.

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Q&A

39. Q: Is there any consideration of integrating the fuel cell APU cooling system with the existing vehicle cooling system?

A: No.

40. Q: Can the fuel cell APU be used for comfort heating?

A: This will likely not be an RFP requirement.

41. Q: What is the definition of all the TRLs (Technology Readiness Levels)?

A: See next slide

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Technology Readiness Levels - for Hardware and Subsystems

	Description	
TRL 1 Basic principles observed and reported.	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties.	
TRL 2 Technology concept and/or application formulated.	Invention begins. Once basic principles are observed, practical applications can be invented. Applications are speculative and there is no proof or detailed analysis to support the assumptions. Examples are limited to analytic studies.	
TRL 3 Analytical & experimental critical functions and/or characteristic proof of concept.	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.	
TRL 4 Component and/or breadboard validation in laboratory environment	Basic technological components are integrated to establish that they will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in the laboratory.	
TRL 5 Component and/or breadboard validation in relevant environment	Fidelity of breadboard technology increases significantly. The basic technology components are integrated with reasonably realistic supporting elements so that it can be tested in a simulated environment. Examples include "high fidelity" laboratory integration of components.	
TRL 6 System/subsystem model or prototype demonstration a relevant environment	Representative model or prototype system, which is well beyond that of TRL 5, is tested in a relevant environment. Represents a major step up in technology's demonstrated readiness. Examples include testing a prototype in a high fidelity laboratory environment, or in a simulated operational environment.	
TRL 7 System/subsystem model or prototype demonstration in a operational environment.	Prototype near, or at, planned operational system. Represents a major step up from TRL 6, requiring demonstration of an actual system prototype in an operational environment, such as an aircraft, vehicle, or space. Examples include testing the prototype in a test bed aircraft.	
TRL 8 Actual system completed and "flight qualified" through test and demonstration.	Technology has been proven to work in its final form and under expected conditions. In almost all cases, TRL represents the end of true system development. Examples include developmental test and evaluation of the system in its intended weapon system to determine if it meets design specifications.	
TRL 9 Actual system "flight proven" through successful mission operations.	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. In almost all cases, this is the end of the last "bug fixing" aspects of system development. Examples include using the	

*Example Images are of Fuel Cell Technologi